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TRANSFER OF TRAINING REVISITED.

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THE TRANSFER OF THE EFFECTS OF TRAINING ONE RESPONSE UPON THE SUBSEQUENT TRAINING OF A DIFFERENT RESPONSE WERE DEMONSTRATED IN EXPERIMENTS USING VERBAL LABELS AND MOTOR RESPONSES. THE EXPERIMENTS PROVIDE AN EXPLANATION FOR LEARNING THAT IS A RESULT OF ASSOCIATING ONE RESPONSE WITH A STIMULUS PREVIOUSLY ASSOCIATED WITH ANOTHER RESPONSE. RESPONSES ARE CHAINED TOGETHER, EACH SERVING AS A DISCRIMINATIVE STIMULUS FOR THE NEXT RESPONSE IN THE CHAIN. CHAINING ALSO EXPLAINS THE ASSOCIATION OF A SECOND RESPONSE TO A STIMULUS WHEN BOTH RESPONSES HAVE PREVIOUSLY BEEN ASSOCIATED WITH ANOTHER COMMON STIMULUS. VERBAL-MOTOR CHAINS SEEM MUCH MORE EFFECTIVE THAN MOTOR-MOTOR OR MOTOR-VERBAL CHAINS OR NO CHAINS IN PRODUCING TRANSFER. MORE ATTENTION SHOULD BE GIVEN TO EXPLORATION OF RESPONSE PROPERTIES INSTEAD OF FOCUSING ALL ATTENTION UPON STIMULUS PROPERTIES IN TRANSFER OF TRAINING. (CG)

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Transfer of Training Revisited

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Transfer of training is a very broad concept the intricacies of which cannot possibly be fully covered in this discussion. Therefore, discussion will be limited to transfer of the effects of training one response (or class of responses) upon the subsequent training of a different response (or class of responses). For example, how does learning verbal labels for stimuli facilitate pairing of motor responses with the same stimuli, or vice versa? Transfer in situations where both verbal and motor responses are paired with common stimuli and then either the verbal or the motor responses are paired with new stimuli will be discussed also.

Children are considered ideal subjects for transfer of training research since they are less likely to automatically give verbal labels to the stimuli used in learning tasks than are adults. Associating verbal labels with stimuli has been found to facilitate later association of motor responses with the same stimuli by children from preschool age through sixth grade. (Cantor, 1955; Gerjuoy, 1964; Katz, 1963; Reese, 1960, 1961; Smith and Goss, 1955; Spiker, 1956; Spiker & Norcross, 1962; Weir & Stevenson, 1959) Association of motor responses with stimuli enabled preschoolers to later give correct verbal labels to the same stimuli. This task had previously been impossible for most of them (Jeffrey, 1958a). Learning to play piano notes to match stimulus tones was found to enable kindergarteners to push the correct buttons associated with the stimulus tones when this was an impossible task for them without such training (Jeffrey, 1958b).

All of the above cited studies have a common format. Namely, two different responses have been associated with a common stimulus. Learning to associate the second response with the stimulus is facilitated after the first response has been associated with the stimulus. Explanations for this phenomenon have typically involved mediation. The assumption is made that a covert response as well as an overt response is learned to each stimulus. Accompanying each covert response is a response

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produced cue which becomes part of the original stimulus which is thus more distinctive. Therefore, when new responses must be learned to the stimuli, the covert responses and accompanying response-produced cues are elicited and help to facilitate learning of new responses to the stimuli. In addition, Spiker (1963) has suggested that Ss with one set of covert responses associated with stimuli may during transfer training actually covertly practice between trials associating the new correct response with the old correct response.

Most emphasis has been placed upon the nature of the original stimulus in determining transfer effects. An alternate explanation for the transfer phenomenon might emphasize the response first learned to the stimulus rather than modifications of the original stimulus. Perhaps the common stimulus serves as a discriminative stimulus for the performance of the first response which then serves as a discriminative stimulus for the second response. Thus, the transfer effect is due to the formation of response chains elicited by the common stimulus. Many will reject this formulation because the first response in the chain does not have to be overtly performed in order for performance of the second response to occur. However, the significantly better transfer task performance of children who are required to make overt verbal responses before making the transfer response than that of children not required to overtly verbalize prior to the transfer task indicates that the verbal response is necessary for transfer to occur. This finding is especially true in preschool children who have been found to have a lower tendency to supply their own verbal labels for stimuli if such labels are not supplied to them by external agents (Flavell, Beach, & Chinsky, 1966; Kendler & Kendler, 1961). Whether the verbal response is overt or covert is immaterial. Some type of intervening response must occur or transfer does not occur.

Recent verbal paired-associate studies (Nikkel & Palermo, 1965; Norcross & Spiker, 1958; Wismer & Lipsitt, 1964) provide an overt demonstration of the importance of the intervening response in producing transfer. Children are first trained to anticipate word B when word A is presented visually. A serves as a discriminative stimulus for response B. In the second phase of these experiments Ss anticipate word C when word

B is visually presented. B serves as a discriminative stimulus for response C. In the transfer phase Ss must anticipate word C when discriminative stimulus A is presented. Children exposed to such training precedures have been found to learn the A-C association significantly faster than they learned associations in which A-B-C chaining produced incorrect responding.

A chaining explanation is also possible in the more complex situation in which many responses are associated with a common stimulus, and then a new stimulus is associated with one or more of the responses. Although the responses may have been associated with the common stimulus at separate times, perhaps the responses themselves became chained together at a later date. Thus, the first response serves as a discriminative stimulus for the next response in the chain. Such an explanation would allow the prediction that association of the first member of the response chain with a new discriminative stimulus would assure the occurrence of the other chain members, also.

Several experiments with children have indicated that the chaining paradigm does lead to the predicted results. Birge (1941) had third, fourth, and fifth grade children learn verbal labels for nonsense figures attached to wooden boxes. "Meef" was the verbal label for two of the boxes, and the other two were called "towk". In the second phase of the experiment one "meef" and one "towk" box were presented simultaneously. Ss learned to find candy under one of the boxes. In a single final trial the "meef" and "towk" boxes not used in Phase 2 were presented, and the Ss had to again find the candy. A significantly larger number than would be predicted on the basis of chance of subjects who were required to overtly verbalize the name of the box they chose when searching for the candy in Phase 2 were correct on the final trial. Some Ss who were not required to make overt verbalizations while searching for candy were also correct on the last trial, but their number did not significantly exceed chance. What happened was essentially that a verbal response and a reaching response were both associated with a common stimulus. Association of the verbal response with a second stimulus led to performance of the reaching response to the second stimulus also, even though they

had never been directly associated. Presumably, the verbal response served as the discriminative stimulus for the appropriate reaching response.

Jeffrey (1953) had an experimental group of preschool children learn a motor response and then a verbal response to a common stimulus. The same verbal response was learned to a second stimulus, also. Then when the common stimulus was presented, Ss had to perform the verbal and motor responses in a chain. The second stimulus was presented and Ss were given the opportunity to perform the verbal-motor chain to it. A second experimental group of the Ss had identical training with the first experimental group except that both response members of the chain were motor. The control group learned to associate the two motor responses with the common stimulus and only one of the motor responses with the second stimulus. But they were not required to overtly chain the two motor responses together following presentation of the common stimulus. When given the opportunity, Ss from all three groups performed the untrained motor response to the second stimulus, but significantly fewer control than experimental group Ss did so. More Ss who learned the verbal-motor chain transferred the untrained motor response to the second stimulus than did Ss who learned the motor-motor chain.

Using mediation theory Jeffrey suggested that the response which was associated with both stimuli served as a mediator for the motor response which had only been associated with one of the stimuli. However, Jeffrey's results could also be explained by use of a chaining model. When a new stimulus is associated with the first member of an already formed response chain, the first response also serves as a discriminative stimulus for the next member of the response chain.

But is chaining the only way in which responses become associated with each other? Are behaviors which have been associated with a common stimulus at different times but never directly associated with one another also related to one another? An indirect answer to this question can be found in several experiments where the effects that manipulation of the frequency of one response had upon the frequency of an unmanipulated response were studied.

Lovaas (1961) found that preschool children who had been reinforced for verbal aggressive behaviors subsequently showed a significantly greater amount of nonverbal aggression than did children who had been reinforced for making nonaggressive verbal responses. Likewise, Sloane, Johnston, and Bijou (unpublished study, 1965) found that when the aggressive motor behavior of a 4½-year-old boy were decreased through differential reinforcement, aggressive verbal behaviors also decreased, although not directly manipulated.

A third study (Baer and Sherman, 1963) found that children reinforced for imitating the nodding, mouthing, and verbal nonsense statements of a puppet also imitated the bar-pressing behavior of the puppet, although they were not reinforced for bar-pressing. When performance of the other imitative responses was no longer reinforced, imitative bar-pressing was the first response to decrease in frequency. Bar-pressing increased again when the other imitative responses were reinforced. When the puppet ceased performing the first three acts for the child to imitate, but continued bar-pressing, the frequency of the child's imitative bar-pressing decreased. When the puppet resumed the first three imitative responses and reinforcement of them, the child's rate of imitative bar-pressing again increased.

It seems implausible that every motor response reinforced in a certain situation has been chained to every verbal response which has also been reinforced in that same situation. But if a chaining model is to account for the results of the previous three studies, just such training must have occurred. Alternately, perhaps every response associated with a common stimulus is automatically associated with other responses associated with the same stimulus without chaining. Possibly, all responses associated with the same stimulus or situation form a functional response class, the members of which are associated with each other and covary. That is, a change made in the frequency of occurrence of one functional response class member also affects the frequency of other class members. The common stimulus serves as a connecting link among all of

the responses (e.g., they become functionally equivalent responses). This type of model would lead one to predict that when some members of the functional response class are associated with a new discriminative stimulus, the other members are also automatically associated with the new stimulus.

A recent study by Arnold (1967) attempted to determine whether the mere association of responses with a common discriminative stimulus leads to the formation of a functional response class such that a manipulation affecting one member of the class also automatically affects the other members. The experiment attempted to minimize chaining. In the previously cited chaining experiments a common discriminative stimulus has always been used, even in control groups. Control group Ss in the Arnold study learned to associate two different sets of responses with two different sets of stimuli during preliminary training while experimental groups Ss learned to perform two different sets of responses to one set of stimuli. Thus, the role of the common discriminative stimulus in the formation of functional response classes could be tested.

There also existed the possability that responses had to be performed and reinforced simultaneously in the presence of common discriminative stimuli in order for functional response classes to be formed. This hypothesis was tested by having one experimental group perform the two responses simultaneously in the presence of the common discriminative stimulus to earn a single reinforcement after the two responses had first been associated with the common stimulus successively. The second experimental group always performed the two responses separately to the common stimulus. If functional response classes could be formed only by associating many responses with a common stimulus, it should make no difference in which order verbal and motor responses were associated with the common stimulus. Therefore, half of the Ss in each group learned to associate animal names with the stimuli first, and half of the Ss learned to push a certain button for each stimulus first.

The previously found relationship between certain subject characteristics and transfer of training prompted investigation of a further question. In a review article

Reese (1962) cited studies which show that preschool age children do not use earlier learned responses to improve their performance in later tasks, while children several years older do. Kindergarten and second grade Ss were chosen to see if they differed in the formation of functional response classes.

Two experimental groups and one control group each contained 32 subjects. Sixteen Ss in each experimental group learned to say five animal names to the stimuli in Phase 1 and to push five black buttons to the same set of five pictorial stimuli in Phase 2. The other sixteen Ss in each experimental group learned button pressing in Phase 1 and animal names in Phase 2. Control Group Ss learned the five animal names to one set of five stimuli and button pushing to a different set of five stimuli in Phases 1 and 2. Order was again counterbalanced. During Phase 3 Experimental Group I Ss performed the verbal and motor responses simultaneously to the appropriate stimuli, while Experimental Group II Ss performed the verbal and motor responses to the appropriate stimuli in random sequence on cue from red and green lights. Control group Ss received the two sets of stimuli combined in random order and performed verbal and motor responses to the appropriate stimuli. All Ss learned the same five verbal and motor responses to the third set of five stimuli in Phases 4 and 5. A comparison of performance on Phase 2 and Phase 5 provided a test of transfer effects. Half of the Ss in each group were second graders and half were kindergarteners.

A four way analysis of variance (Condition x Order x Age x Sex) with repeated measurements (Phase 2 and Phase 5) was performed on both number of errors and number of trials to criterion. The experimental groups made significantly fewer errors and took significantly fewer trials to reach criterion in Phase 5 than they did in Phase 2, but did not differ significantly from each other. Control Group Ss did not differ significantly in number of errors or trials to criterion between Phase 2 and Phase 5. Experimental Ss who learned animal names first to the common and new discriminative stimuli significantly more often performed the untrained responses to the new stimuli

immediately than did Ss who learned buttons first. This finding suggests that the experimental Ss were chaining. It also suggests that the verbal-motor chains used in the present study were easier to form than were motor-verbal chains. Kindergarten Ss made more errors and required more trials to reach criterion when learning to associate the motor and verbal responses with the stimuli than did second graders, but just as many kindergarteners as second graders correctly performed the untrained responses to the new stimuli.

An unequivocal statement about sufficient conditions for the formation of functional response classes cannot be made on the basis of the results of this experiment. Many Ss appeared to be chaining, even though overt chaining of verbal and motor responses was not required or suggested to them. It is also possible that Ss who showed transfer effects without appearance of overt chaining were chaining covertly. And unless chaining can be eliminated, the other model is untestable. The common discriminative stimulus may not even be necessary for the formation of functional response classes. Similar results to the common discriminative stimulus groups in the Arnold experiment may be attained when Ss associate one response with a discriminative stimulus and a second response with the first response but not with the discriminative stimulus.

Additional evidence of chaining was the superiority of transfer in groups who associated verbal responses with the common stimulus first over groups who associated buttons with the common stimulus first. One interpretation that might be made about this order effect is that verbal-motor chains are easier to form than motor-verbal chains. Either overt or covert verbal responses much more frequently precede motor responses than motor responses preceded verbal responses in verbal human organisms. Amount of practice in forming chains of particular types would logically seem to affect ease of learning them.

The fact tha both kindergarten and second grade pupils transferred equally well in spite of the kindergarteners' making more errors and requiring more trials to reach

criterion while learning to associate the responses with the stimuli was unexpected. It appears that kindergarten children can use previously learned responses to aid their learning new responses at least in this type of learning situation.

The superiority of verbal-motor chains over motor-motor or motor-verbal chains or no chaining is not unique to the Arnold experiment. Jeffrey (1953) also found that verbal-motor chains were more effective in producing transfer than motor-motor chains or no required chaining. O'Leary (1967) studied the effects of verbal and nonverbal training upon discrimination learning and immoral behavior. 48 lower middle class first grade boys were first trained to push a button every time a stimulus picture came on the screen for a marble reinforcement. During discrimination training half of the Ss were shown the stimuli one at a time and heard verbal labels for the stimuli, and half of the Ss heard verbal descriptions of the stimuli. When a stimulus came on the screen half of the Ss had to indicate whether it was the right one or not verbally, and half of the Ss had to push the button if the stimulus was correct and shake their heads if the stimulus was incorrect. During the test for immoral behavior all Ss were told that they would again earn marbles for every button press, but that they were only to push the button when the right stimuli came on the screen. Before pushing the button, half of the Ss were instructed to tell themselves audibly whether they could or could not push the button, but the other half of the Ss had no such instructions. The experimenter left them alone for 15 minutes to cheat if they wished. The number of marbles they collected determined the prize they won for participating in the experiment.

Ss who had verbal presentation of the stimuli took more trials to learn the discrimination than Ss who had visual presentation. The manner in which the boys indicated their responses did not influence the rate of discrimination. Ss who were told to verbalize the appropriateness of every response before responding cheated less than those who did not receive such instructions. Neither the method of stimulus presentation nor the manner in which the Ss indicated their answers during discrimination training influenced their immoral behavior. Thus, verbal-motor chains produced superior

behavior change over verbal instructions without chaining required.

In summary, it appears that the chaining together of responses each of which serves as a discriminative stimulus for the next response in the chain is a plausible explanation of the facilitation of learning to associate one response with a stimulus when one has previously associated another response with that stimulus. Chaining also explains facilitation in the association of a second response to a stimulus when both responses have previously been associated with another common stimulus. Verbal-motor chains seem much more effective than motor-motor or motor-verbal chains or no chains in producing transfer. More attention should be given to exploration of response properties instead of focusing all attention upon stimulus properties in transfer of training.

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